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## PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT  
(PCT Article 36 and Rule 70)

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|---|---|--|
| Applicant's or agent's file reference<br>MJB07209WO   | <b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |  |
| International application No.<br>PCT/GB 03/04045  | International filing date (day/month/year)<br>23.09.2003  | Priority date (day/month/year)<br>24.09.2002 |
| International Patent Classification (IPC) or both national classification and IPC<br>B81B1/00 |   |  |
| Applicant<br>THE TECHNOLOGY PARTNERSHIP PLC et al.  |   |  |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
  
 These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

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|--|--|
| Date of submission of the demand<br><br>22.04.2004   | Date of completion of this report<br><br>21.01.2005                          |
| Name and mailing address of the international preliminary examining authority:<br><br> European Patent Office - Gitschiner Str. 103<br>D-10958 Berlin<br>Tel. +49 30 25901 - 0<br>Fax: +49 30 25901 - 840 | Authorized Officer<br><br>Polesello, P<br><br>Telephone No. +49 30 25901-757 |



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB 03/04045

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*

**Description, Pages**

1-7 as originally filed

**Claims, Numbers**

1-25 received on 06.12.2004 with letter of 03.12.2004

**Drawings, Sheets**

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
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International application No. PCT/GB 03/04045

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

|                               |             |                                |
|-------------------------------|-------------|--------------------------------|
| Novelty (N)                   | Yes: Claims | 3,5,8,9,12,18-21,23            |
|                               | No: Claims  | 1,2,4,6,7,10,11,13-17,22,24,25 |
| Inventive step (IS)           | Yes: Claims | 3,5,12,18-21,23                |
|                               | No: Claims  | 8,9                            |
| Industrial applicability (IA) | Yes: Claims | 1-25                           |
|                               | No: Claims  | none                           |

2. Citations and explanations

**see separate sheet**

**Re Item V**

**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

D2: US-A-5 948 684 (HOLL MARK R ET AL) 7 September 1999 (1999-09-07)

2.1. Although device claims 1, 2 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 1, 2, do not meet the requirements of Article 6 PCT.

2.2. Moreover, the terms "the second channel intersects with the first channel *from a first location to a second location*, the first and second locations having *different transverse positions within* the first channel" merely means that the second channel intersects the first channel. In fact, as the channels are tridimensional structures, their intersection gives at least two planes in the transverse direction with respect to a longitudinal one.

2.3. The term "point" used in claims 17 and 24 (lines 21-22) does not refer to any feature which has been previously defined nor is clear in itself, which leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear (Article 6 PCT).

3. Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of claims 1,2,4,6,7,10,11,13-17,22,24,25 is not new in the sense of Article 33(2) PCT, and therefore the requirements of Article 33(1) EPC are not met.

3.1. The document D2 discloses (cf. figure 1 and corresponding text, the references in parentheses applying to this document):

a single layer microfluidic fluid mixer comprising:  
a fluid routing device comprising:  
a first channel (40, 100) having a cross-section of a first aspect ratio and a first depth;  
a second channel (50, 55) having a second cross-section of a second different aspect ratio and a second different depth;  
wherein the second channel (50, 55) intersects with the first channel (40, 100) from a first location to a second location, the first and second locations having different transverse positions within the first channel; and  
fluid supply means (20, 25, 30) for supplying to each channel fluid to be mixed.

The subject-matter of claim 1 is therefore not new (Article 33(2) PCT).

3.2. The document D2 discloses (cf. figure 1 and corresponding text, the references in parentheses applying to this document):

a single layer microfluidic fluid mixer comprising:  
a fluid routing device comprising:  
a first channel (40, 100) having a cross-section of a first aspect ratio and a first depth and having a longitudinal axis;  
a second channel (50, 55) having a second cross-section of a second different aspect ratio and a second different depth;  
wherein the second channel (50, 55) passes through at least part of the first channel (40, 100) in a direction transverse to the longitudinal axis; and  
fluid supply means (20, 25, 30) for supplying to each channel fluid to be mixed.

The subject-matter of claim 2 is therefore not new (Article 33(2) PCT).

3.3. Dependent claims 4,6-11,13-17,22 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to novelty and/or inventive step, the reasons being as follows:

the additional features of claims 4,6,7,10,11,13-17,22 are disclosed in D2 (Article 33(2) PCT);

the features of claims 8 and 9 are merely some of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill (Article 33(3) PCT).

3.4. The document D2 discloses (cf. figure 1 and corresponding text, the references in parentheses applying to this document):

a method of mixing fluid in a single layer, the method comprising the steps of:  
supplying a fluid in a first channel (40, 100) having a cross-section of a first aspect ratio;  
supplying a second channel (50, 55) which has a second cross-section of a second different aspect ratio and a second different depth and which intersects with the first channel (40, 100) from a first location to a second location, the first and second locations having different transverse positions within the first channel;  
passing a portion of the fluid from the first channel (40, 100) into the second channel (50, 55)  
and moving the fluid through the second channel (50, 55) from the first point to the second point; and  
recombining the fluid from the second channel into a different portion of the fluid in the first channel (100).

The subject-matter of claim 24 is therefore not new (Article 33(2) EPC).

3.5. Dependent claim 25 does not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to novelty, the reasons being as follows:

the additional feature of claim 25 is disclosed in D2 (Article 33(2) PCT).

## CLAIMS

1. A single layer microfluidic fluid mixer comprising:  
a fluid routing device having:
  - 5 a first channel having a cross-section of a first aspect ratio and a first depth; and
  - a second channel having a second cross-section of a second different aspect ratio and a second different depth, wherein the second channel intersects with the first channel from a first location to a second location, the first and second locations
  - 10 having different transverse positions within the first channel; and
  - fluid supply means for supplying to each channel fluid to be mixed.
2. A single layer microfluidic fluid mixer comprising:  
a fluid routing device having:
  - 15 a first channel having a cross-section of a first aspect ratio and a first depth and having a longitudinal axis; and
  - a second channel having a cross-section of a second different aspect ratio and a second different depth, wherein the second channel passes through at least part of the first channel in a direction transverse to the longitudinal axis; and
  - 20 fluid supply means for supplying to each channel fluid to be mixed.
3. A mixer according to either claim 1 or claim 2, wherein the cross-section of the intersecting first and second channels is T-shaped.
- 25 4. A mixer according to any one of the preceding claims, wherein the first and second channels are elongate in cross-section.
5. A mixer according to any one of the preceding claims, wherein the aspect ratio of the first channel is a 90° rotation of the aspect ratio of the second channel.
- 30 6. A mixer according to any one of the preceding claims, wherein the first and second channels have substantially the same cross-sectional area.
7. A mixer according to any one of the preceding claims, wherein the total cross-sectional area of the first and second channels is substantially constant.
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8. A mixer according to claim 1, wherein the aspect ratios of the two channels are in the range between 1.5:1 and 10:1.
9. A mixer according to claim 8, wherein aspect ratios of the two channels are in the range between 3:1 and 6:1.
10. A mixer according to any one of the preceding claims, wherein the second channel is separate from the first channel until the first location.
11. A mixer according to any one of the preceding claims, wherein the second channel continues beyond the first channel after the second location.
12. A mixer according to any one of claims 1 to 9, wherein the second channel extends only between the first and the second location.
13. A mixer according to any one of the preceding claims, wherein the second channel is formed by a gradual change in aspect ratio from the first location.
14. A mixer according to any one of the claims 1 to 12, further comprising, at the first location, a step which signifies the start of the second channel.
15. A mixer according to any one of claims 1 to 11 and 13 and 14 when not dependent upon claim 10, further comprising, at the second location, a step which indicates the end of the second channel.
16. A mixer according to any one of the preceding claims, wherein the first and second channels have flow directions which are at 90° to each other.
17. A mixer according to any one of claims 1 to 13, wherein the first and second points are at different longitudinal positions in the first channel.
18. A mixer according to claim 11, wherein the first and second channels are recombined.
19. A mixer according to claim 18, wherein the first and second channels pass through a respective intermediary channel prior to recombination.



20. A mixer according to claim 19, wherein the intermediary channels have the same aspect ratio cross-section.
- 5 21. A mixer according to any one of the preceding claims, further comprising additional fluid routing devices connected in series.
22. A mixer according to any one of the preceding claims, further comprising a pair of inlet passages for supplying, in use, different fluids to the first channel.
- 10 23. A mixer according to claim 22, further comprising a geometric pin between each of the fluid supply passages and the first channel.
- 15 24. A method of mixing fluid in a single layer, the method comprising the steps of:  
supplying a fluid to a first channel having a cross-section of a first aspect ratio;  
supplying a fluid to a second channel which has a cross-section of a second different aspect ratio and which intersects with the first channel from a first location to a second location, each location having a different transverse position within the first channel;  
20 passing a portion of the fluid from the first channel into the second channel;  
moving the fluid through the second channel from the first point to the second point; and  
recombining the fluid from the second channel into a different portion of the fluid in the first channel.
- 25 25. A method according to claim 24, further comprising the step of passing the fluid from the first and the second channel into respective intermediary channels, each of which has the same aspect ratio cross-section, prior to recombining the fluids from the first and the second channels.
- 30